



PACIFIC HERRING (Clupea pallasii) SPAWNING GROUND  
PRODUCTION IN SOUTHEASTERN ALASKA, 1976

By:  
Dennis Blankenbeckler

1976

## ADF&G TECHNICAL DATA REPORTS

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The primary purpose of these reports is presentation of data. Description of programs and data collection methods is included only to the extent required for interpretation of the data. Analysis is generally limited to that necessary for clarification of data collection methods and interpretation of the basic data. No attempt is made in these reports to present analysis of the data relative to its ultimate or intended use.

Data presented in these reports is intended to be final, however, some revisions may occasionally be necessary. Minor revision will be made via errata sheets. Major revisions will be made in the form of revised reports.

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By

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## INTRODUCTION

This is the first in a series of annual reports designed to discuss herring (Clupea pallasii) spawn production in Southeastern Alaska. General aerial surveys on major spawning stocks including two detailed comprehensive surveys are summarized and discussed. Expansion and development of herring sac roe fisheries in Southeastern Alaska have promoted these studies.

### Historical Spawning Ground Surveys

In 1930 the spawning grounds were documented for the first time in Southeastern Alaska by Rounsefell (1930). Updating these early surveys was accomplished in the 1950's by intensive aerial and ground surveys resulting in estimation of egg densities, spawning distribution, predation levels and spawning substrate (Montgomery 1957, '58, '59, '60 and Skud 1959).

Since 1960 the Alaska Department of Fish and Game has conducted annual aerial surveys to monitor herring spawn in terms of linear miles. Effort and intensity of surveys has varied considerably over the years. Limited surveys by skiff and attempts to quantify deposition was accomplished in the 1960's, and again under a newly created Southeastern herring research project initiated in 1969. Results of available information in terms of an index of linear miles of beach receiving spawning is shown in Table 1.

### Biological Studies

The Alaska Department of Fish and Game, recognizing the commercial interest in herring sac roe, has initiated comprehensive spawning ground studies. It is obvious that general aerial surveys denoting presence of spawn are not adequate to evaluate spawning success in Southeastern Alaska. Therefore, pilot studies in 1976 were designed to collect herring life history information and determine the feasibility of estimating the number of spawning herring from their egg deposition. This quantifiable data will be used as ground truth to hydroacoustical estimates made prior to spawn, as a source for estimating egg mortality and as a base for determining harvest quotas. Life history information includes the following:

1. Vegetation type and herring preference.
2. Determination of egg densities for varied substrates.
3. Timing and temperature of spawning.
4. Egg development.
5. Estimates of egg mortality for various densities and substrates.

Table 1. Summary of linear miles of beach receiving herring spawn in Southeast Alaska.

## YEAR AND LINEAR MILES OF BEACH SPAWN OBSERVED

| LOCATION                      | 1953 | 1954 | 1955  | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
|-------------------------------|------|------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| CRANIC                        | 12.2 | 11.7 | 13.6  | 11.6 | 11.5 | 12.6 | 3.5  |      |      | 11.5 | 11.2 | 12.3 | 14.2 | 12.4 | 9.2  |      | 11.7 | 4.5  | 7.5  | 7.1  |      |      |      |      |
| KAH SHAKES<br>SHORE NAKAT     |      | 7.9  | 9.2   | 3.4  | 2.5  | 5.7  | 7.0  |      |      |      |      |      |      |      |      |      | 9.5  |      |      |      | 6.0  | 11.0 | 9.5  |      |
| CLEVELAND PENN.<br>BEHM CANAL |      | 5.9  | 6.4   | 3.5  | 5.9  | 7.8  | 5.5  |      |      |      |      |      |      |      |      |      | 2.0  | 3.0  |      | 1.0  | 2.0  | 1.0  |      |      |
| ERNEST SOUND<br>ROCKY BAY     |      |      | 7.5   | 2.6  |      |      |      |      |      |      |      |      |      |      |      |      | 3.0  |      |      |      |      | 3.0  | 3.0  |      |
| AUKE BAY<br>LYNN CANAL        | 8.2  | 9.4  | 12.2  | 10.0 | 28.1 | 24.1 | 10.8 | 12.9 |      |      |      |      |      |      |      |      | 11.5 | -    | 8.3  | 10.6 | 13.2 | 10.9 | 14.6 |      |
| SITKA                         |      |      | 100.0 | 79.8 | 92.8 | 45.9 | 44.5 |      |      | 19.2 | 20.8 | 23.0 | 15.0 | 16.5 | 15.0 | 11.3 | 13.1 | 10.8 | 7.5  | 2.5  | 8.0  | 10.0 |      |      |
| SEYMOUR CANAL                 |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      | 3.0  |      |      |      |      | 4.5  | 3.3  |      |
| HYDABURG<br>McFARLAND IS.     |      |      |       |      |      |      |      |      |      | 8.0  | 9.0  | 7.8  | 5.0  | 4.5  |      |      | 4.0  | 1.8  | .7   |      |      |      |      |      |
| KWAIN BAY<br>HAM ISLAND       |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      | 3.0  |      |      |      | 3.0  | 3.0  |      |      |
| KASSAN BAY                    |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      | 4.0  | 1.0  | 1.0  | 1.0  | 1.0  |      |      |      |
| HOOD & CHAIK BAY              |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      | 1.5  | 10.0 | 2.0  | 1.7  | 3.4  | 2.3  |      |      |
| GAMBIER BAY                   |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      | .5   |      |      |      |      |      |      |      |
| SKAGWAY HBR.                  |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      | 1.0  |      |      |      |      |      |      |      |
| DAVIDSON IN.<br>MARBLE IS.    |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | 1.0  | 1.0  | 1.0  | 1.0  |      |      |
| PORT CAMDEN                   |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | 0.25 |

This baseline information will be used to develop an efficient, feasible survey method for annually assessing herring escapement and spawning ground conditions.

## METHODS

### Collection of Samples

Divers were used to collect samples documenting certain biological and physical parameters on established transect lines.

Spawning study areas were delineated by systematic aerial surveys in two known spawning areas near Ketchikan and Sitka. Once the spawning area was delineated transects were established at 1/2 mile intervals. A total of 15.75 miles of beach spawning area was comprehensively sampled. Transect lines were set perpendicular to the shore and marked at 5 meter intervals. Divers followed the transect lines until spawn or vegetation disappeared. The majority of transects were surveyed near low tide levels requiring only shallow dives. The transect line was then followed back to the beach documenting depth, temperature, and substrate type and composition. In areas where spawn occurred all vegetation and spawn was collected in a 0.1 square meter sample every 10 meters. In areas where spawn width was narrow (less than 20 meters) samples were taken every 5 meters. A 0.1 square meter sample was collected from a perforated 3/4" plastic pipe frame. Standard diving depth gauges, hand thermometers and underwater slates were used to collect and record other data. Where egg deposition occurred on rock or where unattached eggs occurred visual estimates of numbers were made for the 0.1 square meter sample.

### Laboratory Methods

Eggs were separated from the kelp by manual scraping and using a chemical process similar to that used in British Columbia. The chemical process used was as follows:

Preserve samples of spawn on substrate in Gilson's fluid, a fixative and preservative which hardens the eggs. The Gilson's fluid is of the following mixture:

- 3 gm Mercuric chloride
- 1 ml glacial acetic acid
- 3.75 ml 70% nitric acid
- Dissolved in 230 ml water and 15 ml alcohol

The Gilson's fluid is then decanted from each sample and a 1N KOH solution is added for 60-90 minutes to digest the adhesive material attaching the eggs. The sample container is then immersed in hot tap water. The separated eggs are then preserved in a buffered formol solution for 1 to 1-1/2 days. The buffered formol saline solution is then decanted from the sample.

Gilson's fluid is reapplied to each sample for a period of approximately 10-15 minutes; this hardens the eggs sufficiently to enable a volumetric analysis. Prolonged exposure of the eggs to the Gilson's fluid results in the eggs being dissolved. Therefore, a Gilson application of 10-15 minutes per sample is adequate, yielding an average displacement of 6 ml of water per 1,000 eggs. The Gilson's fluid is then decanted, the eggs are subsampled and densities determined by volumetric analysis. Limited gravimetric analysis was also used on eggs which were scraped from the kelp.

## RESULTS

### Ketchikan Comprehensive Study

Spawning was documented on March 30, 31 and April 1, 2, 3 and 4 from Kah Shakes Point to Kirk Point for a distance of 8 linear beach miles. Spawning near Black Island was documented for 1.5 miles on April 26, 1976. A total of 9.5 miles of spawn was observed. A total of 20 transects were established at 0.5 mile intervals in the spawning area. Nine transects were completed for 5.25 miles of the total (Figure 1). Weather and time were responsible for not completing transects on the total area receiving spawn. Sampling was conducted on April 13, 14, 23 and 24 representing 14 man days of work.

Limited kelp and vegetation common to sandy beaches and semi-protected bays made up the majority of the spawning substrate. A diversity of kelp was observed only in two transects covering rocky substrates. Eel grass (Zostera marina) made up the majority of the spawning substrate. A narrow band of rock kelp (Fucus furcatus) was utilized in the upper intertidal area and incidental spawn was also recorded on sea lettuce (Ulva lactuca).

Aquatic plants observed included:

|             |  |
|-------------|--|
| Brown kelp  | <u>Laminaria bullata</u>               |
| Rock kelp   | <u>Fucus furcatus</u>                  |
| Eel grass   | <u>Zostera marina</u>                  |
| Sea lettuce | <u>Ulva lactuca</u>                    |
| Red dulse   | <u>Rhodomenia palmata forma mollis</u> |

6th Ed. January 12, 1974

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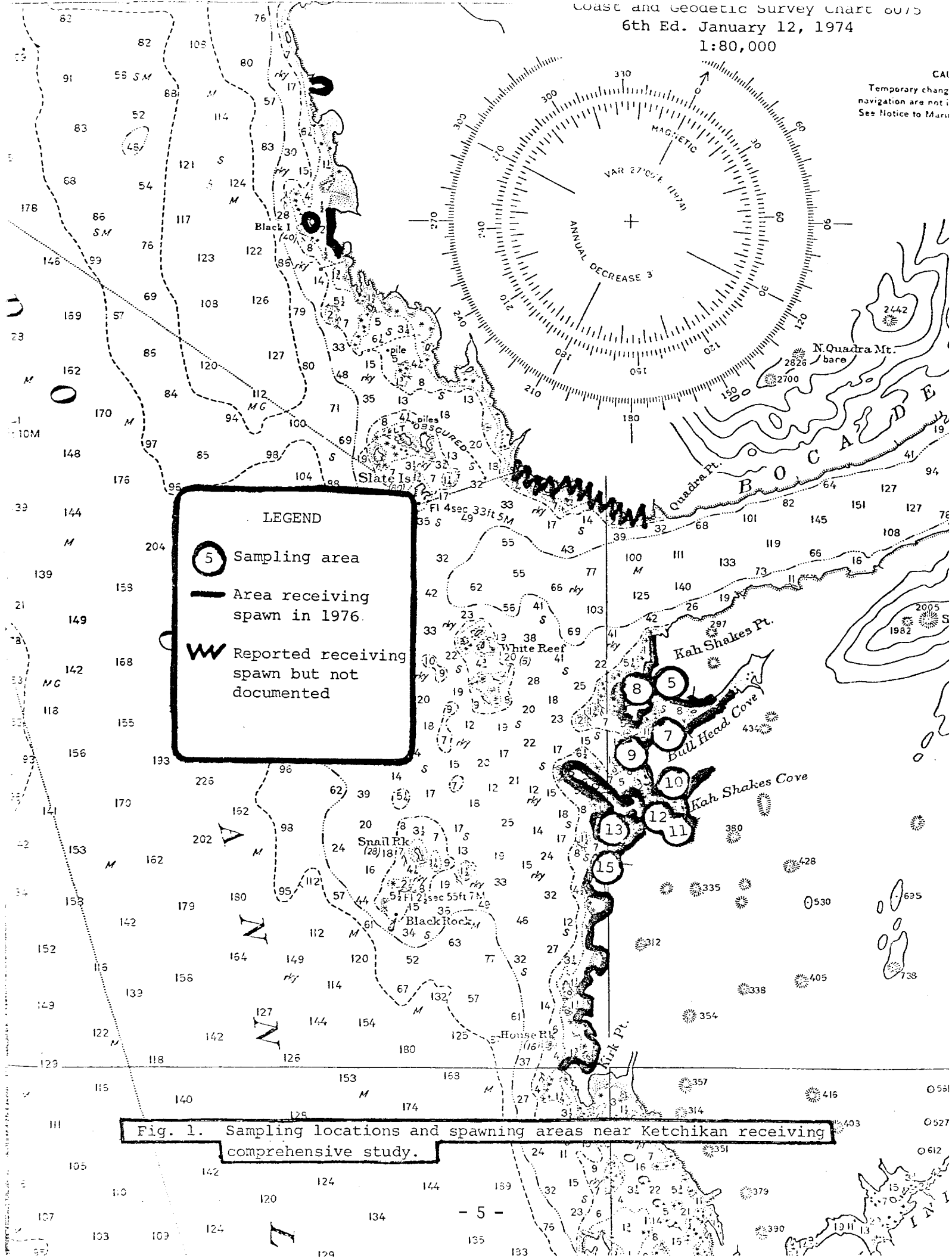


Fig. 1. Sampling locations and spawning areas near Ketchikan receiving comprehensive study.



Surface water temperature was 41° F at the start of spawning on April 13 and 42° F constant to the -30' tide line on April 23. On April 23 eggs were advanced with hatching predicted to commence in 1 or 2 days. The incubation period was determined to be 20-25 days at 41° F to 42° F. Sampling was inadequate to differentiate between incubation periods of sub versus upper intertidal areas.

Depth of spawning was observed from the +12 tide line to a -16' depth. The majority of spawn occurred on Zostera marina from 0 tide level to -10' depth.

Deposition ranged from 0 to 311,740 eggs per sample (0.1 square meter) averaging 377,020 per square meter. Deposition sampling indicated 364 billion eggs were present just prior to hatching (Table 2). This represents  $12.0 \times 10^6$  pounds of herring spawners. This number is determined by using the average fecundity for herring assuming an equal percentage of males and females in the population, and knowing the egg density of the spawning area. Egg mortality was not figured into the estimate, however, heavy gull predation was obviously occurring on the upper intertidal eggs. Egg mortality has been estimated as high as 70-80% in British Columbia (Outram 1961) and 25-40% in Southeastern Alaska (Montgomery 1958).

No herring larvae were observed during the surveys. One transect in Bullhead Cove revealed mounds of loose eggs located in sand depressions. These eggs were protected from the tidal surge and development seemed normal.

No degradation of the spawning beds were noted in the area of the roe fishery. Highest egg densities were recorded in the area of the set gill-net fishery (Bullhead Cove).

No hydroacoustical estimate comparison could be made for this area.

#### Sitka Comprehensive Study

Spawning was documented from April 14 until April 20 in Sitka Sound and the Windy Passage area on Baranof Island for a distance of 13 linear beach miles. A total of 20 transects were set up at 0.5 mile intervals in the spawning area. Eighteen transects were completed of the total. Weather was responsible for not completing the other two transects. Figure 2 illustrates the study area and Table 3 presents a summary of the transects and deposition calculations. Sampling was conducted on May 1 through May 7, 1976 representing 28 man days of work.

Eel grass (Zostera marina) was the most heavily utilized spawning substrate. A narrow band of rock kelp (Fucus furcatus) was utilized extensively in

Table 2. Summary of transects and deposition calculations for Ketchikan study area 1976.

-----8449 meters-----

| Transect Number (spaced at ½ mile intervals) |                        |                              |  |                          |                                   |                       |                                 |                            |                |
|--|------------------------|------------------------------|--|--------------------------|-----------------------------------|-----------------------|---------------------------------|----------------------------|----------------|
|  | 5                      | 7                            | 8                                      | 9                        | 10                                | 11                    | 12                              | 13                         | 15 = 9 transec |
| 30   | x (-6') <sup>a</sup>   | x (-3')                      | *                                      | *                        | *                                 | *                     | *                               | *                          | *              |
| 60   |                        |                              | *                                      |                          |                                   |                       |                                 | x (-7')                    | *              |
| 90   |                        |                              | *                                      |                          |                                   |                       |                                 |                            | *              |
| 120  |                        |                              | *                                      |                          |                                   |                       |                                 |                            | x (-16')       |
| 150  |                        |                              | *                                      |                          |                                   |                       |                                 |                            |                |
| 180  |                        |                              | *                                      |                          |                                   |                       |                                 |                            |                |
| 210  | (Spawning substrate)   |                              |  |                          |                                   |                       |                                 |                            |                |
| 240  | (Zostera, sand, Fucus) | (Zostera, sand, Ulva, Fucus) | (Zostera, sand, Laminaria, Rhodymenia) | (Laminaria, rock, Fucus) | (Zostera, Laminaria, rock, Fucus) | (Zostera, sand, silt) | (Zostera, sand, Laminaria)      | (Zostera, sand, Laminaria) |                |
| 270  |                        |                              |  |                          |                                   |                       |                                 |                            |                |
| 300  |                        |                              | x (-6')                                |                          |                                   |                       |                                 |                            |                |
|  | 5                      | 7                            | 8                                      | 9                        | 10                                | 11                    | 12                              | 13                         | 15             |
| Average                                      |                        |                              |  |                          |                                   |                       |                                 |                            |                |
| Density                                      | 73,188                 | 23,350                       | 124,641                                | 0                        | 0                                 | 0                     | 0                               | 82,033                     | 36,109 =       |
| Total  | 339,321                |                              | Average = 37,702 = .1 sq.              |                          |                                   |                       | 1 sq. m. = 377,020 Ave. Density |                            |                |
| Sample                                       |                        |                              |  |                          |                                   |                       |                                 |                            |                |
| Interval (m)                                 | 10                     | 10                           | 10                                     | -                        | -                                 | -                     | -                               | 10                         | 10             |
| # of   |                        |                              |  |                          |                                   |                       |                                 |                            |                |
| Samples                                      | 3                      | 4                            | 15                                     | 0                        | 0                                 | 0                     | 0                               | 6                          | 11 = 39        |
| Width of                                     |                        |                              |  |                          |                                   |                       |                                 |                            |                |
| Spawn (m)                                    | 30                     | 40                           | 300                                    | 0                        | 0                                 | 0                     | 0                               | 60                         | 110 =          |
| Total  | = 540                  |                              | Average = 60 meters.                   |                          |                                   |                       |                                 |                            |                |

Average width = 60 m.

Length = 8449 m.

Spawning area = 506,940 sq. m.

Total study area deposition = 191,126,518,000 eggs

Total Ketchikan spawning area deposition = 364,065,592,800 eggs

<sup>a</sup> Maximum depth spawn observed from (0) or mean low tide level.

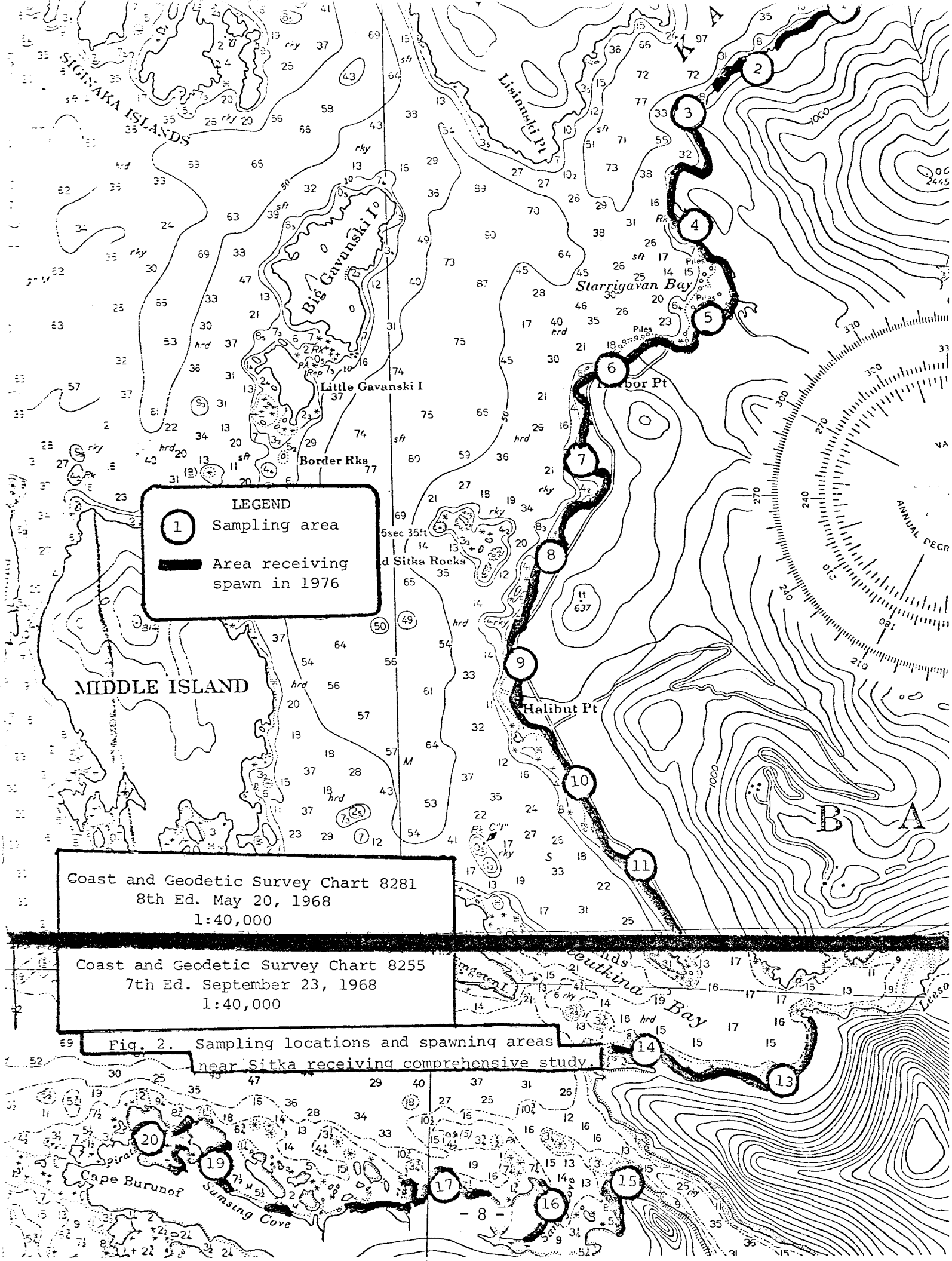


Table 3. Summary of transects and deposition calculations for Sitka study area 1976.

|  |        |        |   |       |   |        |   |        |        |                     |                          |
|--|--------|--------|---|-------|---|--------|---|--------|--------|---------------------|--------------------------|
| -----10,863 meters-----                        |        |        |   |       |   |        |   |        |        |                     |                          |
| Transect Number (spaced at 1/2 mile intervals) |        |        |   |       |   |        |   |        |        |                     |                          |
|  | 1      | 2      | 3 | 4     | 5 | 6      | 7 | 8      | 9      | 10                  | 11                       |
|  | *      | *      | * | *     | * | *      | * | *      | *      | *                   | *                        |
|  | (-1')  | (-5')  |   | (-6') |   | (-9')  |   |        |        |                     |                          |
| 20   |        |        |   |       |   |        |   |        |        |                     |                          |
| 40   |        |        |   |       |   |        |   |        |        |                     |                          |
| 60   |        |        |   |       |   |        |   |        |        |                     |                          |
| 80   |        |        |   |       |   |        |   |        |        |                     |                          |
| 100  |        |        |   |       |   |        |   |        |        |                     |                          |
| 120  |        |        |   |       |   |        |   |        |        |                     |                          |
| 140  |        |        |   |       |   |        |   |        |        |                     |                          |
| Width (meters)                                 |        |        |   |       |   |        |   |        |        |                     |                          |
| (Spawning substrate)                           |        |        |   |       |   |        |   |        |        |                     |                          |
| (Fucus, rock)                                  |        |        |   |       |   |        |   |        |        |                     |                          |
| (Fucus, Laminaria, Ulva, Endocladia, rock)     |        |        |   |       |   |        |   |        |        |                     |                          |
| (Fucus, Laminaria)                             |        |        |   |       |   |        |   |        |        |                     |                          |
| (Fucus, Laminaria, Ulva)                       |        |        |   |       |   |        |   |        |        |                     |                          |
| (Fucus, Laminaria, sand, mud)                  |        |        |   |       |   |        |   |        |        |                     |                          |
| (Laminaria, Zostera, sand)                     |        |        |   |       |   |        |   |        |        |                     |                          |
| (Laminaria, rock)                              |        |        |   |       |   |        |   |        |        |                     |                          |
| (Zostera, Laminaria, Ulva, Lithothamnium)      |        |        |   |       |   |        |   |        |        |                     |                          |
| (Zostera, sand, Cyamathere, Laminaria)         |        |        |   |       |   |        |   |        |        |                     |                          |
| (Zostera, sand, Laminaria, Odonthalia)         |        |        |   |       |   |        |   |        |        |                     |                          |
| (Rock, rubble, sand)                           |        |        |   |       |   |        |   |        |        |                     |                          |
|  | 1      | 2      | 3 | 4     | 5 | 6      | 7 | 8      | 9      | 10                  | 11                       |
| Average  |        |        |   |       |   |        |   |        |        |                     |                          |
| Density  | 66,100 | 38,157 | 0 | 1,677 | 0 | 27,734 | 0 | 15,535 | 17,142 | 72,263              | 0 = Total 238,608        |
| Sample   |        |        |   |       |   |        |   |        |        |                     |                          |
| Interval (m)                                   | 5      | 5      | - | 5     | 0 | 10     | - | 10     | 10     | 10                  | Average 238,608 ÷ 11 =   |
| # of Samples                                   | 1      | 3      | 0 | 3     | 0 | 4      | 0 | 14     | 8      | 10 = 43             | 21,691/.1 sq. meter      |
| Width of                                       |        |        |   |       |   |        |   |        |        |                     | 1 sq. m. = 216,910       |
| Spawn (m)                                      | 5      | 15     | 0 | 15    | 0 | 40     | 0 | 140    | 80     | 100 = Total 395 m = | Average density.         |
|  |        |        |   |       |   |        |   |        |        |                     | Average 395 ÷ 11 = 36 m. |

Average width = 36 m.

Length = 10,863 m.

Spawning area = 380,205 sq. m.

Total study area deposition = 216,910 x 380,205 = 82,470,266,550 eggs.

Total Sitka spawning area deposition = 216,910 x 753,192 = 163,374,876,720 eggs.

<sup>a</sup>Maximum depth spawn observed from (0) or mean low tide level.

the upper intertidal area. Other species of kelp were also used to a lesser degree (Table 4).

Numerous substrates were documented because of the occurrence of a rocky shore promoting a diversity of vegetation. One transect revealed spawn on giant kelp (Macrocystis integrifolia). Methods used to determine densities do not apply to Macrocystis due to the extreme size and branching of the kelp fronds from the bottom to the surface.

The surface water temperature was 41° F at the start of spawning. Temperatures ranged from 44° F to 48° F during May 1-7 prior to hatching (Table 5). On May 5 eggs were advanced with hatching predicted to commence in 1 or 2 days. On May 6 and 7 egg cases and herring larvae were observed in transects 12 through 20. These transects were not considered valid in determining egg densities. Incubation was estimated to be 20-25 days at 41° F to 48° F.

Depth of spawning was observed from the +8' tide line to -20'. The majority of spawn occurred from 0 tide level to -10'. Deposition ranged from 0 to 537,600 eggs per sample (0.1 square meter) averaging 216,910 eggs per square meter. Deposition sampling indicated 163 billion eggs were present prior to hatching. This represents  $5.4 \times 10^6$  pounds of herring. Predation or egg mortality was not evaluated.

No evidence of damage to vegetation was noted; the highest egg densities were observed in the area of the seine fishery near Halibut Point.

Hydroacoustical estimates conducted in March and early April, prior to the sac roe fishery, showed a high biomass of  $14.6 \times 10^6$  pounds of herring concentrated near the spawning ground. A harvest of  $1.6 \times 10^6$  pounds occurred on April 15, allowing an escapement of 13.0 million pounds. The deposition sampling did not account for  $7.6 \times 10^6$  pounds or 58%. A 58% egg mortality would not be considered abnormal based on other research in Southeast Alaska (25 to 40%, Montgomery 1958 and 70 to 80% in British Columbia, Outram 1961).

#### ACKNOWLEDGMENTS

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Table 4. Kelp species observed and herring spawning occurrence observed in Sitka study area.

| Aquatic Vegetation |                                 | Herring           |
|--------------------|---------------------------------|-------------------|
| Common Name        | Generic Name                    | Spawn<br>Observed |
| Eel grass          | <u>Zostera marina</u>           | X                 |
| Rock kelp          | <u>Fucus furcatus</u>           | X                 |
| Hair kelp          | <u>Odonthalia floccosa</u>      | X                 |
| Sugar wrack        | <u>Laminaria saccharina</u>     | X                 |
| Blister wrack      | <u>Laminaria bullata</u>        | X                 |
| Sea girdle         | <u>Laminaria groenlandica</u>   | X                 |
| Nail brush         | <u>Endocladia muricata</u>      | X                 |
| Sea lettuce        | <u>Ulva lactuca</u>             | X                 |
| Seersucker         | <u>Costaria costata</u>         | X                 |
| Soft tooth brush   | <u>Odonthalia lyallii</u>       | X                 |
| Sea spatula        | <u>Pleurophycus garidneri</u>   | X                 |
| Triple rib         | <u>Cyamathere triplicata</u>    | X                 |
| Polly Pacific      | <u>Polysiphonia pacifica</u>    | X                 |
| Giant kelp         | <u>Macrocystis integrifolia</u> | X                 |
| Red dulse          | <u>Rhodomenia palmata</u>       |                   |
| Sea sac            | <u>Halosaccion glandiformes</u> |                   |
| Wing kelp          | <u>Alaria valida</u>            |                   |
| Sea staghorn       | <u>Codium fragile</u>           |                   |
| Sea colander       | <u>Agarum cribrorum</u>         |                   |
| Red rock crust     | <u>Lithothamnium</u>            |                   |

Table 5 Summary of temperature profiles for Sitka comprehensive study May 1 to 7, 1976.

| Date   | Transect | Temp. F. | Depth Feet |
|--------|----------|----------|------------|
| 5-1-76 | 1        | 45       | surface    |
|        | "        | "        | 12         |
| 5-1-76 | 2        | 45       | surface    |
|        | "        | "        | 20         |
| 5-1-76 | 4        | 48       | surface    |
|        | "        | "        | 2          |
|        | "        | "        | 5          |
|        | "        | "        | 6          |
|        | "        | "        | 8          |
|        | "        | 45       | 10         |
|        | "        | 43       | 15         |
|        | "        | "        | 20         |
|        | "        | 42       | 25         |
|        | "        | "        | 35         |
| 5-5-76 | 11       | 48       | surface    |
|        | "        | "        | 8          |
|        | "        | "        | 10         |
|        | "        | "        | 12         |
|        | "        | "        | 15         |
|        | "        | 46       | 20         |
|        | "        | 45       | 28         |
|        | "        | "        | 35         |
|        | "        | 44       | 45         |
| 5-6-76 | 16       | 46       | surface    |
|        | "        | "        | 2          |
|        | "        | "        | 5          |
|        | "        | "        | 6          |
|        | "        | "        | 10         |
|        | "        | "        | 12         |
|        | "        | 45       | 15         |
|        | "        | "        | 20         |
|        | "        | "        | 25         |
|        | "        | "        | 36         |
| 5-7-76 | 19       | 46       | surface    |
|        | "        | "        | 15         |

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